CS 676 **KNOWLEDGE REPRESENTATION** **Spring 1996**

SYLLABUS REVISED VERSION, 24 JANUARY 1996 (all revisions underlined)

PREREQUISITE: CS 572 or permission of instructor.

INSTRUCTOR: Prof. William J. Rapaport, 214 Bell Hall, 645–3180 x 112, rapaport@cs.buffalo.edu
home page at URL http://www.cs.buffalo.edu/pub/WWW/faculty/rapaport/
Office Hours: TBA and by appointment.

CLASS MEETINGS:

REGISTRATION NO.	DAYS	FROM	TO	LOCATION
226944	TTh	11:00 A.M.	12:20 P.M.	220 NSC

TEXTS & OTHER SOURCE MATERIAL:

- Brachman, Ronald J., & Levesque, Hector J. (eds.) (1985), *Readings in Knowledge Representation* (Los Altos, CA: Morgan Kaufmann).
- Ginsberg, Matthew L. (1987), *Readings in Nonmonotonic Reasoning* (Los Altos, CA: Morgan Kaufmann); on reserve at UGL/SEL.
- Martins, João Pavão (1995), *Knowledge Representation* (Lisbon: Artificial Intelligence Group, Department of Mechanical Engineering, Instituto Superior Técnico);
available in /projects/rapaport/676/ and on reserve at UGL/SEL.
- Reichgelt, Han (1991), *Knowledge Representation: An AI Perspective* (Norwood, NJ: Ablex Publishing Corp.).
- Webber, Bonnie Lynn, & Nilsson, Nils J. (eds.) (1981), *Readings in Artificial Intelligence* (Palo Alto: Tioga Publishing Co.); on reserve at UGL/SEL.

TOPICS:

Knowledge representation (KR) is the part of AI that is concerned with the techniques for representing (and reasoning about) the information to be used by an AI program. If, as Nicklaus Wirth has said, programs = algorithms + data structures, then AI programs = AI algorithms + KR techniques. Topics will incluse classical and non-classical logics, non-monotonic logics, truth-maintenance (belief-revision) systems, semantic networks (including SNePS), frames, "hybrid" systems such as KL-ONE, and more recent developments such as KIF and CYC.

COURSE REQUIREMENTS:

- You will be expected to attend all lectures and to complete all readings and assignments on time. No programming will be required.
- From time to time, information will be posted to the newsgroup sunyab.cs.676, which you should read on a regular basis.
- Students should notify the instructor within the first two weeks of class if they have a disability which would make it difficult to carry out course work as outlined (requiring notetakers, readers, extended test time).
- The final course grade will be determined on the basis of a weighted function of (a) class attendance and participation and (b) a term project.

- The term project may be either a programming project or a research report. Possible *programming projects* are: application of an existing KR system to solve some problem in AI, implementation of an existing KR system, development of a new KR system designed for a specific AI-related purpose, etc. The final report for a programming project must include: (a) a technical report (in the style of a paper in a conference proceedings) describing the project, the system, and the application domain and (b) one or more appendices containing annotated sample runs and annotated code (as appropriate). Possible *research report* topics are: a discussion of a KR system or technique that was *not* covered in class, a comparison of different KR systems or techniques, a discussion of a philosophical or foundational isssue in the field of KR, a literature review of some KR topic, etc. All programming and research reports must follow the writing guidelines to be handed out in class.
- A proposal for your term project, consisting of an extended abstract and bibliography is due no later than Tuesday, March 12; no late proposals will be accepted, and no term projects will be accepted without an approved proposal. The final term project is due no later than Monday, May 6.

Incompletes:

It is University policy that a grade of Incomplete is to be given only when a small amount of work or a single exam is missed due to circumstances beyond the student's control, and that student is otherwise doing passing work. I will follow this policy. Incompletes will normally have to be made up by the end of the Fall 1996 semester.

TENTATIVE SCHEDULE OF TOPICS AND READINGS

DATE	TOPIC	READING ASSIGNMENT FOR NEXT TIME
T Jan. 23	Introduction	Martins, Ch. 1 Reichgelt, Chs. 1–2 Smith, B. C. (1982), "Prologue to 'Reflection and Semantics in a Procedural Language'," in B&L: 31–39. Rapaport, W. J. (1992), "Logic," 'Logic, Propositional," and "Logic, Predicate," in S. C. Shapiro (ed.), *Encyclopedia of Artificial Intelligence, 2/e* (New York: Wiley): 851–853, 891–897, 866–873; on reserve at UGL/SEL.
Th Jan. 25	Classical Logic	Martins, Ch. 2 Reichgelt, Ch. 3 Moore, R. C. (1982), "The Role of Logic in Knowledge Representation and Commonsense Reasoning," in B&L: 335–341.
T Jan. 30		McCarthy, J. (1968), "Programs with Common Sense," in B&L: 299–307.
Th Feb. 1		Martins, Ch. 3 McCarthy, J. (1979), "First Order Theories of Individual Concepts and Propositions," in B&L: 523–533. McCarthy, J., & Hayes, P. J. (1969), "Some Philosophical Problems from the Standpoint of Artificial Intelligence," in Webber & Nilsson.
T Feb. 6	Non-Classical Logic	Hayes, P. J., "The Frame Problem," in Webber & Nilsson.
Th Feb. 8		Moore, R. C. (1977), "Reasoning about Knowlege and Action," in Webber & Nilsson.
T Feb. 13		Martins, Ch. 4 Reiter, R. (1978), "On Reasoning by Default," in B&L: 401-410 *and/or* Reiter, R., "A Logic for Default Reasoning," in Ginsberg McCarthy, J. (1977), "Epistemological Problems of Artificial Intelligence," in B&L: 23–30 *and/or* McCarthy, J. (1980), "Circumscription —A Form of Non-Monotonic Reasoning," in Ginsberg.
Th Feb. 15	Non-Monotonic Logic	Martins, Ch. 5 Doyle, Jon, "A Truth Maintenance System," in Webber & Nilsson and in Ginsberg.
T Feb. 20	Truth-Maintenance	Martins, J. & Shapiro, S. C. (1983),

		"Reasoning in Multiple Belief Spaces," *IJCAI–83* (Los Altos, CA: Morgan Kaufmann), Vol. 1, pp. 370–373.
Th Feb. 22		Martins, Ch. 6 Reichgelt, Ch. 5 Quillian, M. R. (1967), "Word Concepts: A Theory and Simulation of Some Basic Semantic Capabilities," in B&L: 97–118 Winston, P. H. (1975), "Learning Structural Descriptions from Examples," in B&L: 157–209.
T Feb. 27	Semantic Networks	Woods, W. A. (1975), "What's in a Link: Foundations for Semantic Networks," in B&L: 217–241.
Th Feb. 29		Brachman, R. J. (1979), "On the Epistemological Status of Semantic Networks," in B&L: 191–215.
T Mar. 5		Shapiro, S. C., & Rapaport, W. J. (1987), "SNePS Considered as a Fully Intensional Propositional Semantic Network," in N. Cercone & G. McCalla (eds.), *The Knowledge Frontier* (New York: Springer–Verlag): 262–315. Maida, A. S., & Shapiro, S. C. (1982), "Intensional Concepts in Propositional Semantic Networks," in B&L: 169–189.
Th Mar. 7		Schank, R. C., & Rieger, C. J. (1974), "Inference and the Computer Understanding of Natural Language," in B&L: 120–139.
T Mar. 12		Etherington, D. W., & Reiter, R. (1983), "On Inheritance Hierarchies with Exceptions," in B&L: 329–334 *and/or* Thomason, R. (1992), "NETL and Subsequent Path-Based Inheritance Theories," in *Computers and Mathematics with Applications* 23: 179–204; in SEL, `Per QA76 .C58118`
Th Mar. 14		Martins, Ch. 7 Reichgelt, Ch. 6 Minsky, M. (1981), "A Framework for Representing Knowledge," in B&L: 245–262. Bobrow, D. G., & Winograd, T. (1977), "An Overview of KRL, a Knowledge Representation Language," in B&L: 263–285.

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SPRING BREAK

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T Mar. 26	Frames	Hayes, P. J. (1979), "The Logic of Frames,"

		in B&L: 287–295.
Th Mar. 28		Martins, Ch. 8 Reichgelt, Ch. 7 Brachman, R. J., & Schmolze, J. G. (1985), "An Overview of the KL-ONE Knowledge Representation System," *Cognitive Science* 9: 171–216; on reserve at UGL/SEL. Woods, W. A., & Schmolze, J. G. (1992), "The KL-ONE Family," *Computers and Mathematics with Applications* 23: 133–177; in SEL, `Per QA76 .C58118` *and/or* Brachman, R. J.; Fikes, R. E.; & Levesque, H. J. (1983), "KRYPTON: A Functional Approach to Knowledge Representation," in B&L: 411–429.
T Apr. 2	Hybrid Systems	Martins, Ch. 9 Reichgelt, Ch. 9 Brachman, R. J. (1979), "On the Epistemological Status of Semantic Networks," in B&L: 191–215. Newell, A. (1980), "The Knowledge Level," *AI Magazine*; on reserve in UGL/SEL Woods, W. A. (1983), "What's Important About Knowledge Representation?", *Computer* 16 (October): 22–27.
Th Apr. 4	NO CLASS	
T Apr. 9	General problems	Nilsson, N. J. (1991), "Logic and Artificial Intelligence," *Artificial Intelligence* 47: 31–56. Birnbaum, L. (1991), *Artificial Intelligence* 47. Brooks, R. A. (1991), "Intelligence without Representation," *Artificial Intelligence* 47: 139–159.
Th Apr. 11		TBA
T Apr. 16	CYC	TBA
Th Apr. 18		TBA
T Apr. 23	Knowledge Sharing	TBA
Th Apr. 25		TBA
T Apr. 30		TBA
Th May 2	LAST CLASS	

CONDITIONS OF USE OF COMPUTING & INFORMATION TECHNOLOGY FACILITIES

The use of University at Buffalo academic computer systems by members of the university community is authorized by Computing & Information Technology (CIT). All classes of users (students, faculty, and staff members) have the responsibility to use CIT's services in an effective, efficient, ethical, and legal manner.

Every computer account issued by University at Buffalo is the responsibility of the person in whose name it is issued. Therefore, it is mandatory that the owner of an account be careful to keep the account secure by keeping the password secret, changing the password often, and reporting to Academic Services, CIT if anyone else is using the account.

Authorized Use.

As a condition for use of the CIT computing systems, all users are expected:

1. To keep their password private and not allow anyone else to use their account.
2. To respect the privacy of others. For example, users shall not intentionally seek information on, obtain copies of, or modify files or passwords belonging to others.
3. To respect the integrity of the University at Buffalo computing systems. For example, users shall not intentionally develop or use programs that harass other users, infiltrate a computing system, or damage or alter the software components of a computing system.
4. To not develop programs or use any mechanisms to alter or avoid accounting for the use of computing services or to employ means by which the facilities and systems are used anonymously or by means of an alias. For example, users shall not send messages or mail, or print files which do not show the username of the user using the system or which exhibit a username other than that of the sender.
5. To respect the legal protection provided by copyright and licenses held by the CIT. For example, users shall not make copies of a licensed computer program to avoid paying additional license fees.
6. To use the accounts only for University related purposes. For example, users shall not authorize individuals who are not associated with the University to use an account nor use the academic computers for non-university related work.

Violation of these conditions, i.e., unauthorized use of another person's account, tampering with other users' files or passwords, or harassment of other users, is certainly unethical and possibly a criminal offense. Violators will be dealt with according to the "Student Rules and Regulations" and/or Chapter 514 of the New York State Penal Law. Whenever CIT becomes aware of a possible violation of these conditions, Academic Computing will initiate an investigation. In order to prevent further unauthorized activity, CIT may suspend the authorization of computing services to the individual. Confirmation of unauthorized use of the facilities may result in the closing of accounts permanently, billing for computer time used for non-university endeavors, disciplinary action, and/or legal action.

Responsible use.

Users are expected to use computing resources in a responsible and efficient manner consistent with the instructional, research, and administrative goals of the University. Users are expected to refrain from engaging in deliberate wasteful practices such as sending chain letters through electronic mail, printing unnecessary listings, printing multiple copies of files, performing endless unnecessary computations, or unnecessarily holding public terminals, tape drives, or dial-up phone lines for long periods of time when others are waiting for these resources. In addition, the playing of games or using networks for purely recreational purposes when others are waiting for terminals represents irresponsible use of the equipment.

CIT prefers not to act as a disciplinary agency or to engage in policing activities. However, in cases of unauthorized or irresponsible behavior, CIT reserves the right to take remedial action, commencing with an investigation of the possible abuse.